Participatory Vulnerability and Capacity Assessment (PVCA) of Four Major Lakes in Malawi

Fisheries Integration of Society and Habitats (FISH)

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Cover Page Photograph: Lake Chilwa is drought prone and has dried up three times in recent years.

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Acronyms

ADC	Area Development Committee
BVC	Beach Village Committee
CA	Christian Aid
CCA	Climate Change Adaptations
CDA	Community Development Assistant
CSA	Climate Smart Agriculture
DDO	District Development Officer
CEPA	Centre for Environmental Policy and Advocacy
CISER	Community Initiative for Self-Reliance
CPC	Civil Protection Committees
DFO	District Fisheries Officer
DOF	Department of Fisheries
ECRP	Enhancing Community Resilience Program
EPA	Extension Planning Area
EI	Emmanuel International
FISH	Fisheries Integration of Society and Habitats
FGD	Focus Group Discussion
GoM	Government of Malawi
KII	Key Informant Interview
LUANAR	Lilongwe University of Agriculture and Natural Resources
PVCA	Participatory Vulnerability and Capacity Assessment
URI-CRC	University of Rhode Island- Coastal Resource Center
USAID	United States Agency for International Development
VCPC	Village Civil Protection Committee
VDC	Village Development Committee
VNRMC	Village Natural Resources Management Committee
VSLA	Village Savings and Loans Association
WESM	Wildlife and Environment Society of Malawi

CLIMATE CHANGE TERMINOLOGY (USAID, 2007)

"Climate is what you expect, weather is what you get"

WEATHER describes atmospheric conditions at a particular place in terms of air temperature, pressure, humidity, wind speed, and precipitation.

CLIMATE is often defined as the weather averaged over time (typically, 30 years).

CLIMATE VARIABILITY refers to variations in the mean state of climate on all temporal and spatial scales beyond that of individual weather events. Examples of climate variability include extended droughts, floods, and conditions that result from periodic El Niño and La Niña events.

CLIMATE CHANGE refers to shifts in the mean state of the climate or in its variability, persisting for an extended period (decades or longer). Climate change may be due to natural changes or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

VULNERABILITY to the impacts of climate change is a function of exposure to climate conditions, sensitivity to those conditions, and the capacity to adapt to the changes.

ADAPTATION are actions taken to help communities and ecosystems moderate, cope with, or take advantage of actual or expected changes in climate conditions.

EARLY WARNING SYSTEMS are described as a set of capacities needed to generate and disseminate timely and meaningful warning information to enable communities threatened by a hazard to prepare and to act appropriately in sufficient time to reduce the possibility of harm or loss (ISDR, 2009).

Executive Summary

This report provides an analysis and evaluation of the current and prospective vulnerability to climate change of the people around the four Lakes in Malawi, namely, South East and South Western Arm of Lake Malawi, Lakes Chilwa, Chiuta and Malombe. It focuses on identifying and understanding the communities' vulnerabilities (and their underlying causes) and capacities which can inform local level action plans to enhance their climate proofing, resilience to shock and reduce the effects of climate change.

The study was conducted through focus group discussions (FGD) from four villages around the lakes and was triangulated through key informant interviews (KII) from different local committees: Village Civil Protection Committees (VCPC), Village Natural Resources Management Committees (VNRMCs), Area Development Committees (ADCs), Village Development Committees (VDCs), Village Health Committee, Beach Village Committees (BVC), Fisheries Associations (FA), school committees and farmer groups.

The results show that the incidence of drought (dry spells), floods and strong *mwera* winds in recent times, increasingly affect the communities. Most reported disruption of their livelihoods through degradation of land resources (i.e. from flooding) and destruction of food and cash crops (i.e. both from floods, droughts and high winds), infrastructure damage (e.g. overtopping of roads), and loss of community and household productive assets. In some cases causing death at sea (from storms) and due to flooding. These have social, economic, and environmental adverse effects on the communities because they result in health hazards, food insecurity, loss of social cohesion, and can lead to natural resource destruction. Community members as coping strategies, tend to resort to unsustainable livelihoods such as charcoal burning for sale and fishing (leading to overfishing). The study further established that the available human, natural (indigenous) and social capacities within the communities and the central and decentralized local government and traditional authorities are inadequate for reducing communities' vulnerability to these hazards. Climate proofing was needed.

The report therefore concludes that enhancing the capacity of communities and their local village committees; promotion of integrated natural resources management skills; supporting climate-smart agriculture technologies; and provision of knowledge and early warning, and promotion of alternative/complementary livelihoods, can increase the communities' resilience to the effects of climate change. The results of this analysis will subsequently be used by FISH to guide the project's activities to reduce the vulnerability of communities to the impacts of climate change, as well as to support the monitoring and evaluation of the project's activities. Findings will also be fed into the development of disaster risk reduction strategies at the district level, by inclusion in the district development plans.

1 Background

1.1 Climate Change and Development

According to USAID (2007), climate change creates both risks and opportunities. By understanding, planning for and adapting to a changing climate (i.e. taking a climate change adaptation (CCA) approach), individuals and societies can take advantage of opportunities and reduce risks.

The consequences of climate variability and climate change are potentially more significant for the rural poor. Vulnerability to the impacts of climate change is a function of the risk of exposure to climate variables, sensitivity of their livelihoods to those variables, and the adaptive capacity of the affected community. Often, the poor are dependent on economic activities that are sensitive to the climate. For example, agriculture and forestry activities depend on local weather and climate conditions; a change in those conditions could directly impact productivity levels and diminish livelihoods (Carr et al., 2009). Adapting to climate change involves reducing exposure and sensitivity and increasing adaptive capacity and climate proofing livelihoods. Depending upon the development challenge being addressed, this may be done by modifying a traditional approach or by taking a new, climate smart approach.

Climate variability can cause abrupt disruptions, such as floods, droughts, or tropical storms. These disruptions can take a major toll on a country's economy particularly in situations where a significant part of economic activity is sensitive to the weather and climate i.e. hydroelectricity which is the mainstay of the country's power supply. For example, Malawi IFPRI (2010) reported that on average Malawi loses US$12.5 million, or 1 percent of GDP, each year due to droughts. Severe droughts, such as the one that occurred in 1991-92, can reduce national GDP by 10 percent. The 1991/92 drought, coupled with trade impacts due to the Mozambique conflict, internal political difficulties and the temporary suspension of development aid, resulted in inflation reaching 75 percent in 1994/95, up from 12.5 percent in 1990/91 (IIED, 1998). Furthermore, on average Malawi loses US$9 million, or 0.7 percent of GDP, each year due to floods in the southern region of the country that reduce agricultural productivity, destroy fish and wildlife habitat and displace people.

1.2 Fisheries Integration of Society and Habitats (FISH) project

Pact in partnership with the University of Rhode Island Coastal Resources Center (URI-CRC), the Centre for Environmental Policy and Advocacy (CEPA), Community Initiative for Self-Reliance (CISER) and Christian Aid (CA), are jointly implementing the five-year, USAID-funded Fisheries Integration of Society and Habitats (FISH) project from 2014-2019. Christian Aid has sub-contracted Emmanuel International (EI) and Wildlife and Environment Society of Malawi (WESM) and URI-CRC have subcontracted the services of World Fish and Lilongwe University of Agriculture and Natural Resources (LUANAR). The project is implemented in collaboration with the Department of Fisheries (DOF), Department of Wildlife and National Parks, and the Ministry of Agriculture, Irrigation and Water Development (MAIWD).

The target groups of the FISH project are the fishing communities living within 10 km of the following four ecological freshwater systems: the South East Arm (SEA) and South West Arm (SWA) of Lake Malawi, Lake Malombe, Lake Chiuta and Lake Chilwa. These four freshwater bodies fall under the four districts in the southern region of Malawi namely Mangochi, Machinga, Balaka and Zomba,

Malawi's ecosystems are being continually degraded by a combination of local and climatic changes that are adversely impacting fisheries resources and the communities that rely on them to support their livelihoods. As such, one of the main objectives of FISH is to increase communities' resiliency to climate change and improve biodiversity conservation through effective sustainable fisheries co-management.

Specific activities to be carried out related to climate change adaptation are informed and driven by the Environment Threats and Opportunity Assessment (ETOA) conducted by FISH and this Participatory Vulnerability and Capacity Assessment (PVCA). For the ETOA, the FISH project has drawn from evidence based information from scientific literature related to climate change impacts on, and resilience of, fishing communities in the project area. To complement this, a participatory rapid assessment (PRA) and Strengths, Weakness, Opportunities and Threats (SWOT) assessment was conducted. These studies engaged local stakeholders and fishers in mapping biodiversity and climate change threats and hotspots across the four lakes to augment and verify the information gathered in the literature review. This information serves as the backdrop for this PVCA and in addition, Chancellor College and URI-CRC, undertook a GIS analysis to produce a vulnerability mapping of the FISH target areas.

This PVCA will support the FISH team to focus interventions to alleviate the effects of climate change on freshwater ecosystem biodiversity and associated livelihoods, and support the development of resilient communities through climate smart adaptations. The intention is to identify the threats and source geographic locations (i.e. hot spots) where the threats from climate change are greatest and where interventions under FISH could have the most beneficial results. Pre-project reviews and assessments suggested that FISH should largely focus CCA interventions under Output 4 on the ecosystems around Lakes Chilwa and Chiuta. Here it was felt that the impacts of climate change have been most dramatic, manifested through large fluctuations in water levels and periods of drying up, with greater frequency of damaging floods. However, rainfall data suggests Lake Malombe and Lake Malawi located in the Rift Valley, are also rainfall dependent affecting water level, and that the areas are in a rain shadow and as such communities will have to adapt to the foreseen future drier conditions.

1.3 Background to Climate Change and the Four Lakes

Lake Malawi, Chilwa and Chiuta have shown that they are highly sensitive to climate change (Jamu, 2011; Jul-Larsen et al., 2003; Dulanya et al., 2013). Water levels have continued dropping in recent times following a series of years of decrease in the rainfall season and warmer conditions, leading to an increase in evaporation rates from the lake (Dulanya et al., 2013). Kumambala et. al. (2010) further show that it is very unlikely in the near future that the water level in Lake Malawi will once again increase to a maximum height of 477m above mean sea level (amsl) as was the case in 1980. Studies have shown that fish production, especially the Chambo is sensitive to lake level. Notably, 3 years after a lake rise, the Chambo catches increase as the high water level favours the juveniles seeking refuge in flooded vegetation, and contributes to more breeding fish which mature 2 years later (Tweedle, Pers Comm).

An increase in air temperature will mean a rise in water temperature, coupled with changing rainfall patterns and fluctuating lake levels, will directly impact fish reproduction, growth, and migration patterns. Fish being cold blooded, growth is temperature dependent. This could have indirect impact on fish biodiversity through changes in habitats, stocks, and species distribution (Vollmer et al., 2005 and Bootsma, et al 2005). The deeper waters of Lake Malawi have already become warmer due to a reduction in cold water intrusion and warmer winters (Jamu Pers Comm, citing Ngochera, 2014). This warming may suppress upwelling in Lake Malawi, reducing pelagic productivity which is dependent on this nutrient re-cycling, with consequences for the production of Usipa. The study postulated, that elevated water temperatures in shallow areas may cause fish to migrate to deeper cooler waters, making fish less accessible to the artisanal fishermen using canoes and small planked boats. Conversely, the positive thermos-tactic fish, like Tilapia, tend to exhibit a diurnal migration in search of warmer waters, and could penetrate more into the shallows where they are exposed to the illegal fishing with mosquito net lined beach seines.

Lake Chilwa, for example, is driven by cyclic changes in water levels which are mainly influenced by annual rainfall (60 percent of the lakes water budget is direct rainfall) and evaporation patterns determine seasonal lows. However, the changes in lake levels are to some extent influenced by accelerated environmental degradation in the lake’s catchment area. Historical mean annual river discharge in four of the six major rivers flowing into Lake Chilwa has declined by up to 90 percent between 1965 and 2011. This was due, in part, to the low rainfall recorded across that period but also to the increasing deforestation in the forested catchment (that resulted in decreased water storage and concomitant increase in surface flow) (LCBACCP, 2013).

Sustainable fisheries resources development in Malawi needs a thorough assessment of the impact of climate change on the future water levels of key ecosystems like Lakes Malawi, Malombe, Chiuta and Chilwa. Lower lake levels will affect the fisheries negatively as less nutrients (from run-off) are entering the lake and the low water hinders breeding with far reaching consequences on the Malawian economy.

Fluctuating water levels have been associated with varying fish catches/production and changing of dominant species in following years (e.g. Chambo). These changes have affected the livelihoods of the fishing communities surrounding the four lakes.

Furthermore, drying of these lakes and their catchments can be of national food security concern in terms of loss in protein source from fisheries and lower crop yields (e.g. decrease in rice production, drought reducing maize yields) from wetlands that are associated with these lakes. In some years, high precipitation has also affected the surrounding communities in the form of flash floods which result from upstream land degradation due to deforestation and erosion due to poor agricultural and management (Carr et al., 2009). Flooding, contributes to increased siltation which is believed to have a direct impact on biodiversity, notably the rock dwelling Mbuna and other fish that breed and feed in rocky habitats. Many breeding areas have already been covered by mud and the situation is predicted to get worse (Jamu Pers Comm, citing Matiya and Donda, 2014). Climate change will also increase the vulnerability of rain-fed smallholder farmers. Droughts are predicted by the Malawi Meteorological Department to become more common, leading to lower production and increased food insecurity.

Rural households have few safety nets and buffers and are highly susceptible to climate-related shocks, such as droughts and flooding events. The adaptive capacity is low and all of the factors described above, including small and declining farm sizes, lack of livelihood options, poor governance, lack of capital, and food insecurity all contribute to household vulnerability that is exacerbated by climate change.

1.4 Existing National Assessments of Vulnerability

The GoM’s Department of Disaster Management Affairs (DoDMA) conducted a national assessment of community vulnerability to climate change in 2015 in partnership with the USAID and the Regional SERVIR program (DoDMA, 2015). They used a variety of indicators for exposure, sensitivity and adaptive capacity to determine likely vulnerability to climate change-induced hazards over the coming decades. The study used past hazards and resulting sensitivities to predict future vulnerabilities. Much of the indicators were focused on the 85 percent of the public engaged in agriculture and the resulting maps below (Figures 1.1 to 1.4) show a modest level of variability across the FISH project area. Mangochi district is singled out amongst those that show high sensitivity to climate and in particular the lakeshore areas of Lakes Malawi and Malombe (Chowe area) which are drought prone. Likewise, Balaka and Machinga show high vulnerability, which implies the Middle Shire and Lake Chiuta areas are also extremely sensitive to climate change. The Lake Chilwa area in Zomba district scored a medium vulnerability due to low sensitivity and high adaptive capacity.

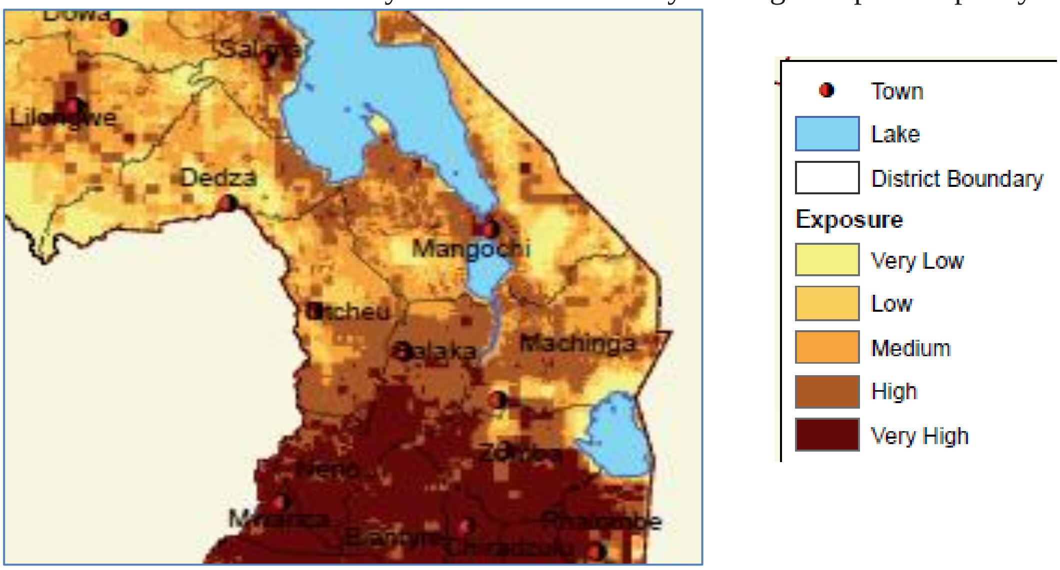


Figure 1.1 Exposure to climate change (from DoDMA 2015)

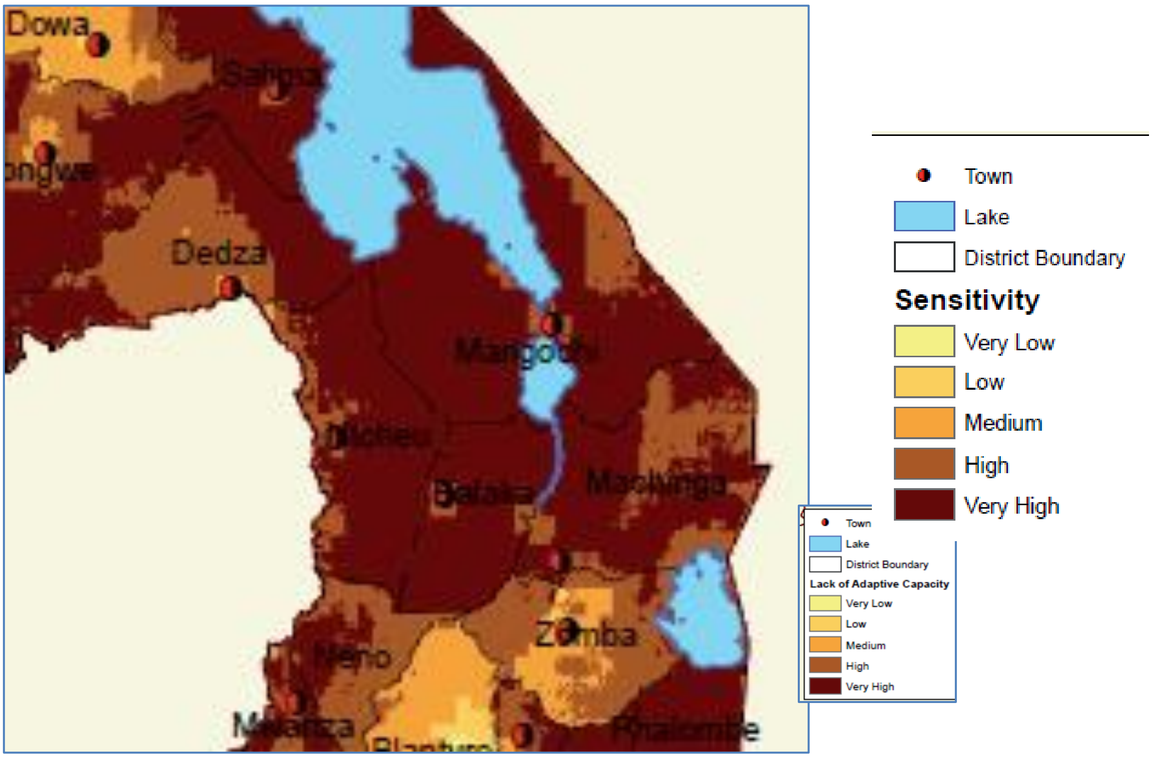


Figure 1.2 Sensitivity to Climate Change (from DoDMA 2015)

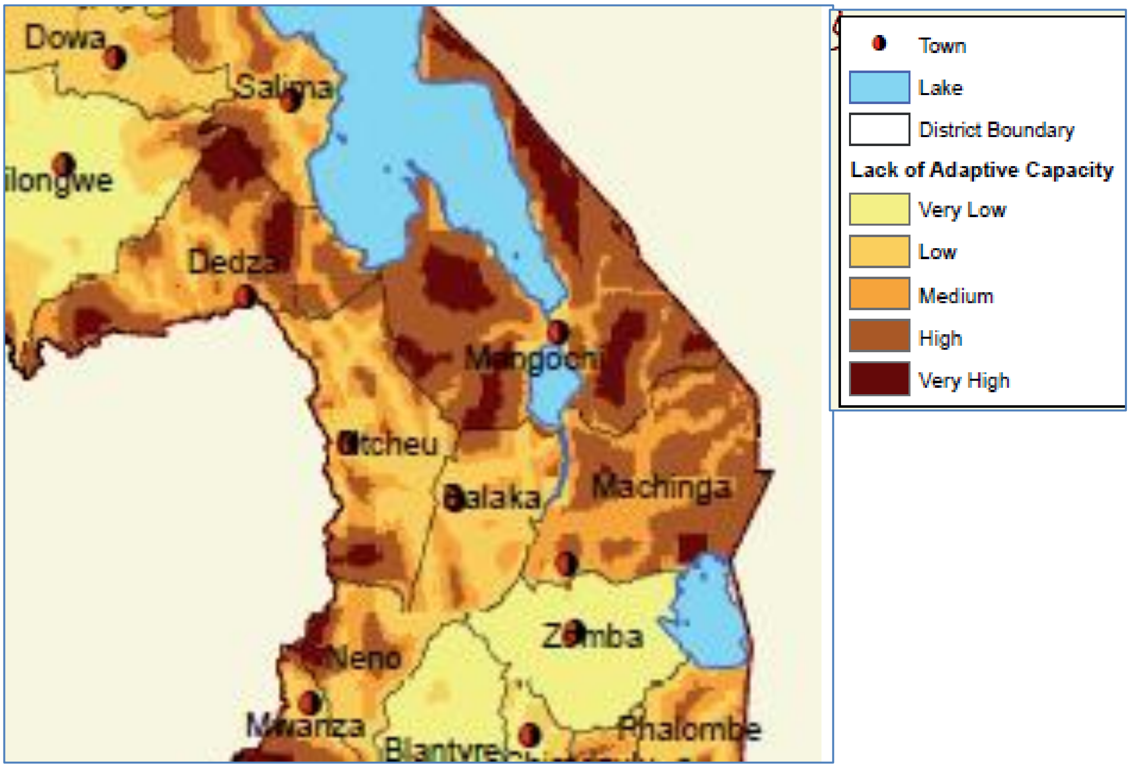
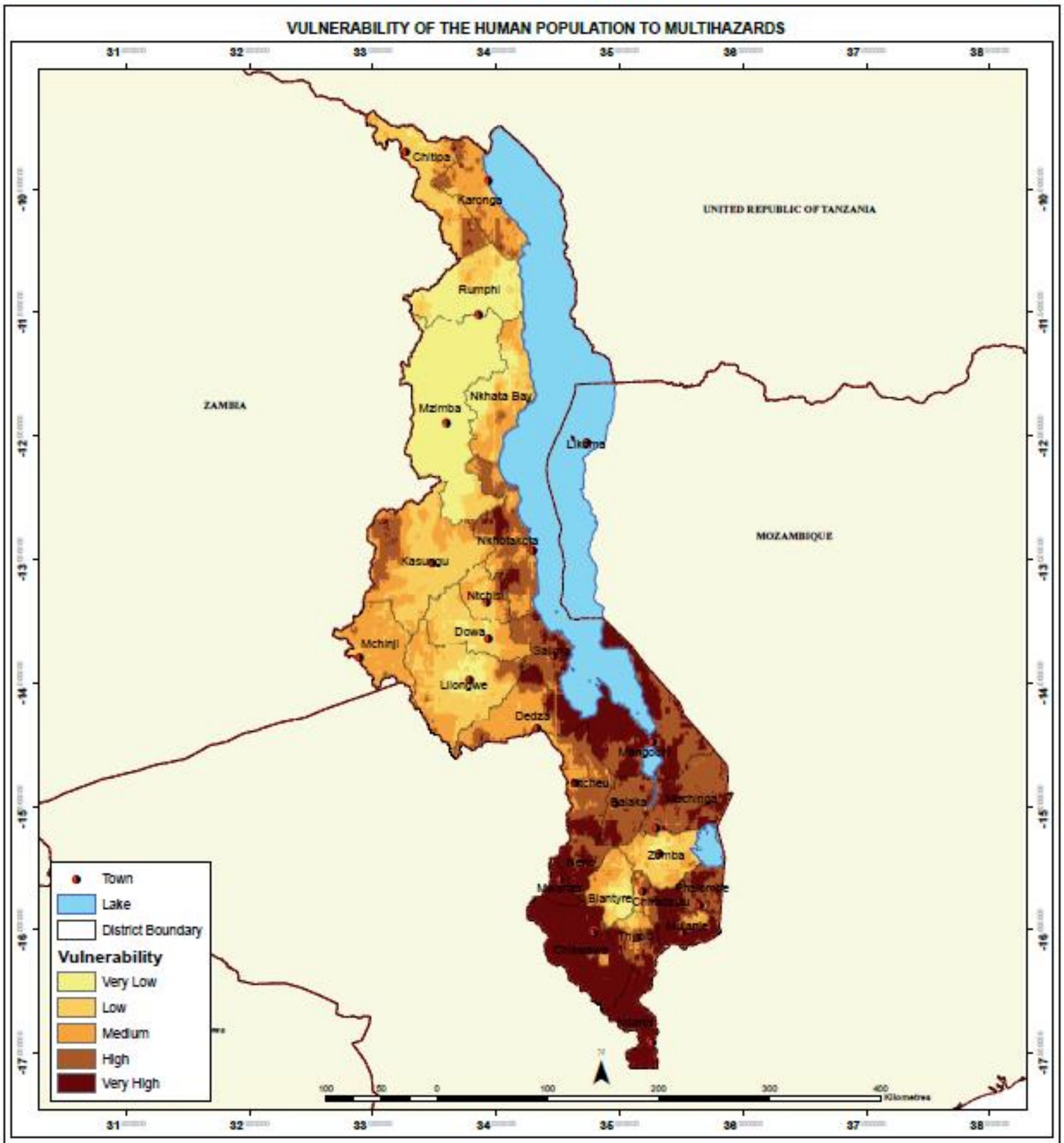


Figure 1.3 Lack of Adaptive Capacity to Climate Change (from DoDMA 2015)



This map shows the severity of vulnerability in Malawi. Very high vulnerability is observed in the Southern region and some parts of the Central region. The whole country is vulnerable. Relatively, the most vulnerable districts are Chikwawa, Nsanje, and Mangochi while hotspots of high and very high vulnerability are also observed in some parts of Neno, Mulanje, Chiradzulu, Machinga, Dedza, Thyolo, Phalombe, Balaka, Salima, Karonga and Chitipa. All other districts show lower levels of vulnerability.

Vulnerability class	Population
Very Low	1,769,053
Low	4,810,942
Medium	3,439,754
High	3,377,711
Very High	3,238,604
Total	**16,636,064**

Figure 1.4 Overall Vulnerability to Climate Change Map based on the GoM and SERVIR analysis

1.5 Rapid Mapping of Climate Change Vulnerability in Project Communities

Recognizing the large area covered by the FISH project and the limited focus on the fisheries sector from the DoDMA (2015) hazards analysis, the FISH Project piloted a rapid climate change vulnerability mapping exercise, collaborating with Chancellor College to conduct the analysis (CRC, 2015). The analysis focused on the FISH project area, and due to the limited climate data and models available, focused on past hazards and sensitivity. The Intergovernmental Panel on Climate Change (IPCC) conceptual framework was adopted, which separates vulnerability into three components: exposure, sensitivity, and adaptive capacity to climate stressors. The study assessed the general vulnerability of the communities within the project's 10km buffer zones around the lakes with a focus on the fisheries sector, since most communities are engaged in multiple livelihoods. By combining existing national data sets with data collected during the PRA visits with the Beach Village Committees (BVCs), the results provide a more detailed vulnerability analysis that has to date not been achieved through other national assessments. The rapid assessment used current hazards as part of the exposure analysis to assess the variability of vulnerability across the area.

The vulnerability mapping study selected 15 indicators (table 1.1) and collectively teased out the elements of "exposure, sensitivity and adaptive capacity" of the communities so as to predict likely vulnerability to climate change. Multiple informed assumptions were made based on what drives sensitivity and adaptive capacity, though the indicators are similar to those conducted in other studies of this nature.

Table 1.1. Parameters used to Assess Climate Vulnerability Mapping

Indicator
EXPOSURE INDICATORS
Drought severity
Flooding areas
Rainfall amounts (precipitation)
Deforestation in catchments
Lake drying areas
Sediment levels in rivers (link to deforestation/riverbank health)
Wind Strength
SENSITIVITY INDICATORS
Dambos
Drought tolerant crops
Farm land in floodplain
Productivity of farm land per hectare
Houses/ critical infrastructure in flood zone
Condition of transportation infrastructure
Poverty Levels
Infection rates (HIV, Malaria, Bilharzia or Cholera)
Distance to Trading Centers
Number of types of fishing gear used
ADAPTIVE CAPACITY INDICATORS

Soil health (community wide) use maize map
Level of Livestock
Distance to boreholes
Irrigation systems
Material wealth?
Ability of BVC to deliver services
Consistency of policy/ governance between gov't and chiefs
Mother education level
Remittance levels
Level of illegal gear use
Number of livelihoods per household
Level of savings

Results from the FISH mapping exercise (Figure 1.5-1.8) show some differences from the DoDMA analysis. The FISH maps showed higher exposure scoring for the flood areas of Lake Chilwa in Zomba district as well as a lower exposure for the Mangochi area. Regarding sensitivity, the FISH maps showed greater variation but overall less sensitivity compared to the DoDMA maps. In terms of adaptive capacity, the FISH analysis produces similar results though the Lake Malombe area shows a little more adaptive capacity compared to the DoDMA result. Adding the three composite scores together resulted in some pockets of high vulnerability in the FISH project area compared to other regions within the surrounding lake areas and the DoDMA analysis. These high vulnerability areas include:

- The Cape Maclear area of Lake Malawi,
- The southwest section of Lake Chiuta,
- The central western section of Lake Chilwa and
- Select areas of the central eastern section of Lake Malombe.

The primary factors for their high vulnerability varied for each place though flood and drought exposure were a major factor for Chilwa and Chiuta Lake areas. Other factors for high vulnerability are localized rain shadow areas around the lakes, except for Mbwadzulu, Namiasi and Maldeco in the SEA and Makanjira in the SWA (UNDP, 2015).

This vulnerability mapping exercise produced greater variation of scores/vulnerability across the FISH project area, which provides some insight for guiding management actions. Taking the high vulnerability areas and matching it with known lakeshore fishing communities, FIDH was able to identify some high risk areas, also called hotspots. These include:

- The western shores of Lakes Chilwa and Chiuta,
- The central western areas of Lake Malombe and Cape Maclear.

This set the stage for the PVCA study.

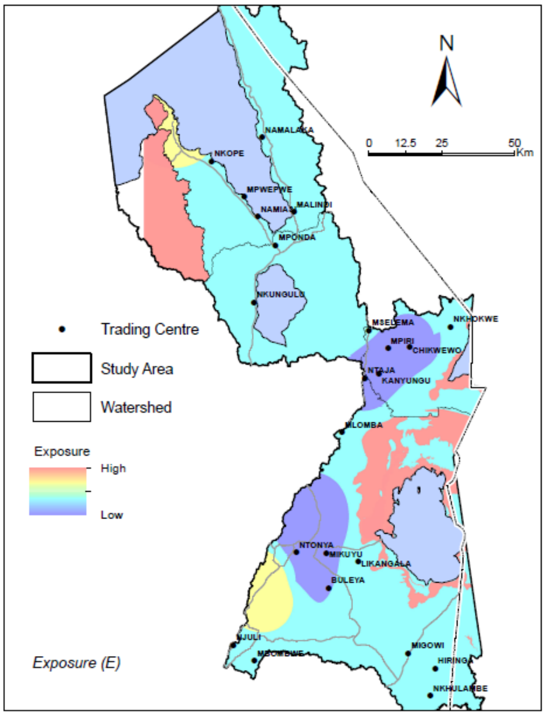


Figure 1.5 Composite Score for Exposure from FISH assessment (CRC 2015)

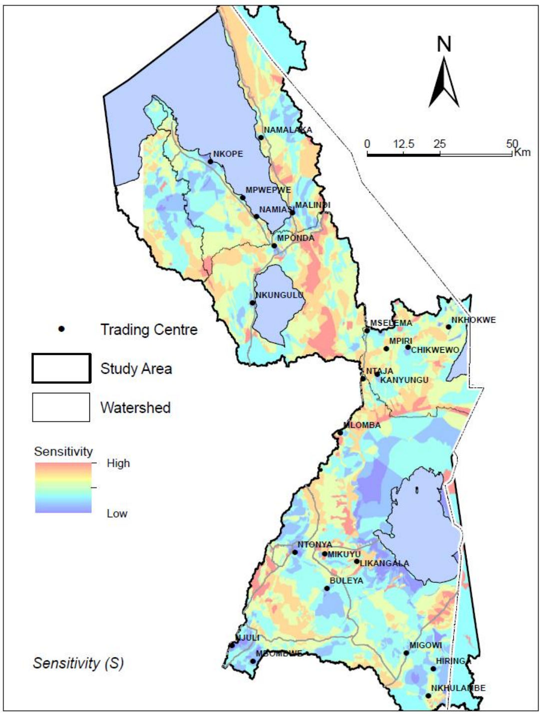


Figure 1.6 Composite Score for Sensitivity from FISH assessment (CRC 2015)

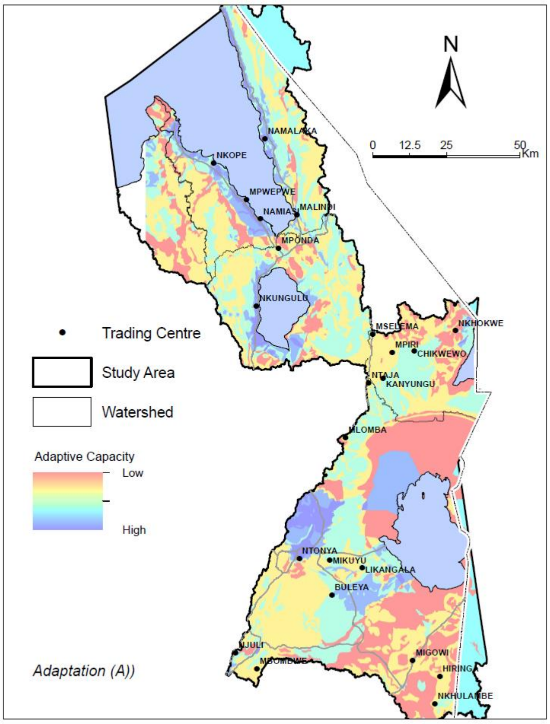


Figure 1.7 Composite Score for Adaptive Capacity from FISH assessment (CRC 2015)

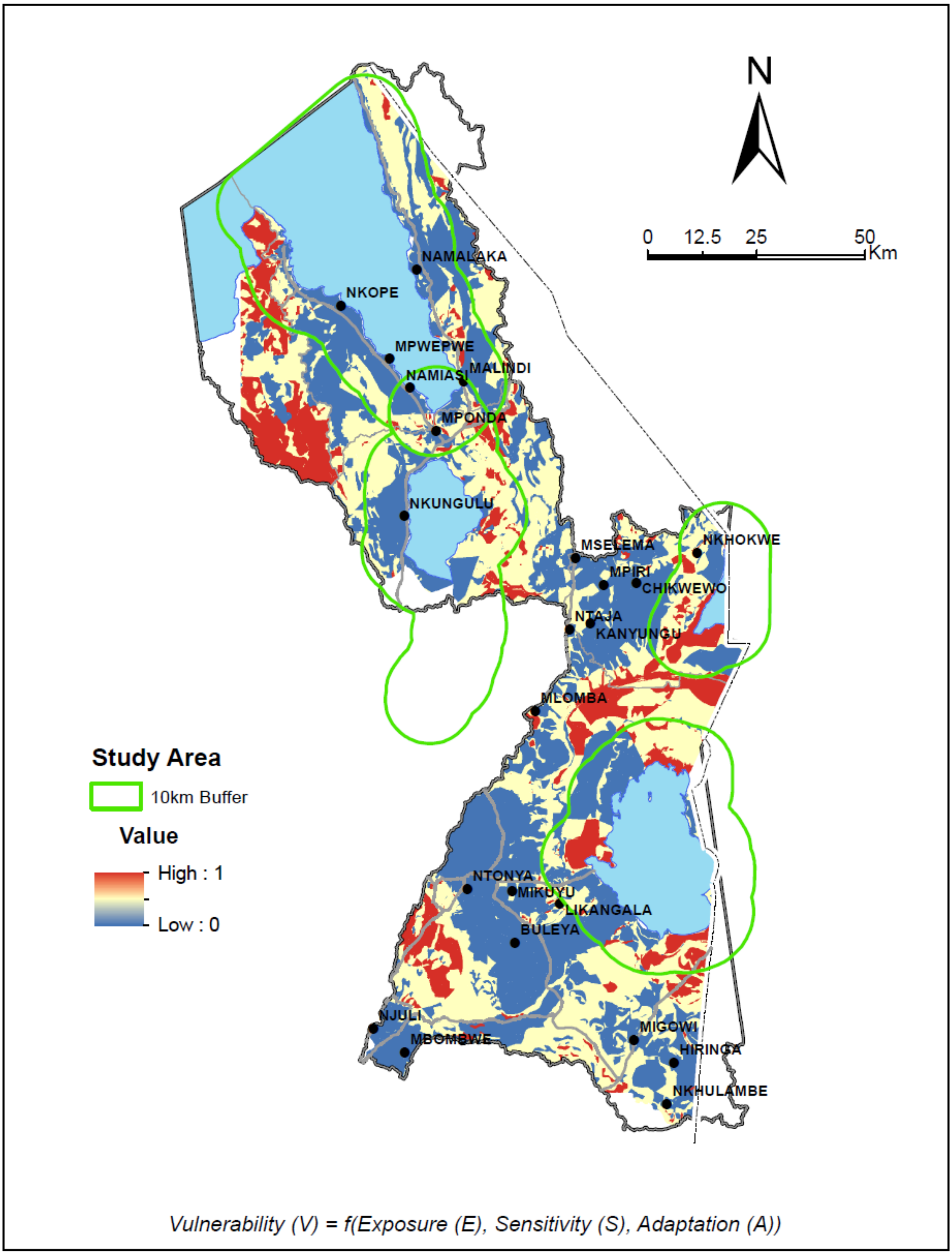


Figure 1.8 Climate Change Vulnerability Map produced by FISH (CRC, 2015).

A score of 1 is high vulnerability and a score of zero is low vulnerability. The FISH project area of 10km from each lake is highlighted by the green boundary lines.

Parts of the FISH project's analysis of community vulnerability to climate change was integrated into the larger ETOA study. FISH therefore sought to understand the communities' underlying vulnerabilities to climate change and capacities to inform the interventions that could be sustainably and effectively implemented. In essence, the vulnerability takes into consideration that the communities around the lakes have the option to go fishing as a climate coping strategy in the event of climate failure or disaster, and therefore is different to the national vulnerability mapping.

2 The Participatory Vulnerability and Capacity Assessment Process

The participatory vulnerability capacity assessment was conducted in four group village headmen (GVH) areas of the four lakes.

Participatory Vulnerability and Capacity Assessment (PVCA) is a process that empowers community members using participatory tools to systematically analyse how they perceive their problems linked to climate change, and to suggest their own context-specific solutions an how to overcome those problems (Christian Aid, 2009). It is an essential disaster-risk-reduction tool which can be used for designing livelihood or poverty reduction interventions. PVCA is an action-oriented approach to vulnerability assessment, which culminates in participatory, grassroots and community-based planning and instils local action so as to avoid raising expectations. The PVCA also helps reveal the links between the different kinds of risks a community faces and ways in which the members of that community interact. It uses participatory methods to define vulnerabilities to gain a more nuanced understanding of how local communities are reacting to the experience of climate change locally. This information can be particularly valuable in informing more quantitative measures of vulnerability. Moreover, by incorporating ranking exercises, the PVCA also facilitates individual, household, and community targeting of key vulnerability.

2.1 Specific Objectives of the PVCA

The PVCA had the following specific objectives:

1. To identify specific climate change issues which directly affect the 4 lakes' communities (living within a distance of 10km from the shoreline), the fishery and other livelihoods in the FISH project area.
2. To establish and document local understanding of the underlying causes of climate change issues around these four lakes, and how it is impacting livelihoods.
3. To diagnose vulnerabilities to climate shocks as well as their underlying causes i.e. this was done as a baseline that takes a broad view of vulnerable situations and how this is exacerbated by climate.
4. To identify specific climate change vulnerable community groups, or hotspots, known hazards, and/or locations of known climate impacts.
5. To understand the impact of climate change on the communities' livelihoods, economy and food security.
6. To establish available capacities within the communities to harness local knowledge to implement mitigating actions.

7. To assist communities to develop local adaptation plans and interventions to be included in Village and District Development Plans.
8. To contribute towards the development of the FISH project baseline.

2.2 PVCA Methodology

The PVCA was conducted in Mangochi, Balaka, Machinga and Zomba districts within the 10km zone surrounding the four lakes that constitutes the FISH project area (Table 2.1). In each district, group village headmen were randomly sampled using the nth rule of research sampling (Ntakoma pers comm citing Descombe, 2003). It was determined that a study at GVH level was adequate to provide a better representative sample as respondents/participants would come from all the GVH villages providing a logical sample representative of each lake.

Table 2.1 FISH PVCA Communities Interviewed for the PVCA by lake

Site	Villages represented	Participation	Key informants	Water body/district
GVH Nalikolo, TA Chowe - Mangochi	9	66 (46 women & 20 men)	3 (3 ADC men)	L. Malombe
GVH Kela, TA Mponda - Mangochi	6	47 (39 women & 8 men)	2 (1 VDC woman & 1 BVC man)	L. Malawi
GVH Mauluka, STA Nkagula, TA Kuntumanje-Zomba	8	87 (56 women & 31 men)	3 (2 VDC & 1 VNMCs all men)	L. Chilwa
GVH Dinji , TA Ngokwe - Machinga	7	52 (37 women & 15 men)	4 (2 FA men, 1 VCPA man, 1 lead farmer (man)	L. Chiuta
Total sample size 4 GVHs	30	252 (178 women & 74 men)	12 (1 woman & 11 men)	

2.2.1 Focus Group Discussions

Focus group discussions (FGDs) were conducted in four randomly selected GVH sites (one for each of the four lakes). In these sites the PVCA was conducted ensuring that both gender and all age groups were accorded a fair opportunity to effectively participate and contribute towards the conclusions drawn by this study. The PVCA approach was used to obtain information on issues at community level. The questionnaire that Christian-Aid had used in past PVCA exercises within the catchment was adapted to this study (Christian Aid, 2011). The questionnaire was also used to guide the discussions in relation to what information was critically needed to respond to the needs of the study (Annex 1).

To provide a conducive interactive environment, at each meeting the groups were divided into smaller groups which promoted participation of all members in each group and the information was consolidated for each site. In many cases these smaller groups brought out very similar information which then made consolidation and triangulation easier.

At each focus group discussion, all villages under a particular GVH were represented at least with a minimum of six people. A total of 252 community members (i.e. 178 women and 74 men) from the four sites participated in the group discussions.

2.2.2 Key Informants Interviews

The PVCA was triangulated by interviews (using the same questionnaire) to consult key informants. These were mostly VDC, ADC, Village Civil Protection Committee (VCPC) and Village Natural Resources Management Committee (VNRMC) members at any given site. This was used to triangulate some information that was provided in plenary groups. At least two key informants were contacted at each site to clarify and provide more nuanced understanding of different issues that emanated from the plenary discussions. In addition to the FGDs and key informant interviews, the PVCA was done using the following tools (Table 2.2).

Table 2.2 Other Participatory Vulnerability Capacity Assessment tools used in the survey

Tool	Objective/Use
Ranking	▪ Was used to prioritize vulnerabilities, risk, interventions, challenges and solutions. ▪ The communities agreed on the three priority hazards and ranked them by voting with the first being the most severe in their perception (Figure 4.1)
Seasonal Calendars	▪ To establish trends and frequencies and time in a particular time space. They are a useful means of generating information about seasonal trends within the community and identifying periods of particular stress and vulnerability.
Maps	▪ Were used to enhance the understanding of their context and to establish critical climate change hotspots and effects on resources (Figure 3.1)
Historical timelines	▪ Was used to establish progressive developments of vulnerabilities over the years. See the trends in the graphs (Figure 4.2) below for each hazard for a particular water body

2.3 Limitations of the PVCA Study

The major limitation of the study had to do with communities' perception to two-dimensional mapping (Figures 2.1). In two sites (GVH Nalikolo and Kela) it was evident that their participation was limited in some tasks by low literacy levels, especially in comprehending the mapping exercise. Few members were able to understand what was expected of them despite the explanations that were clearly made in their local dialect. In some cases they seemed not to actually know how to represent in 2 dimensions their geographic positions in relation to other points and features in their GVHs. It was apparently clear that possibly they could not conceive the idea of representing the physical on-the-ground reality on the chalk board or flip chart let alone on the open ground. Although maps were obtained, participation was limited to the few who understood what was expected of them. Key to the exercise is that despite this limitation, all participants could agree on the climate shocks in terms of areas within their localities which were more affected than others, and ultimately could show this on a map (Figure 2.1).

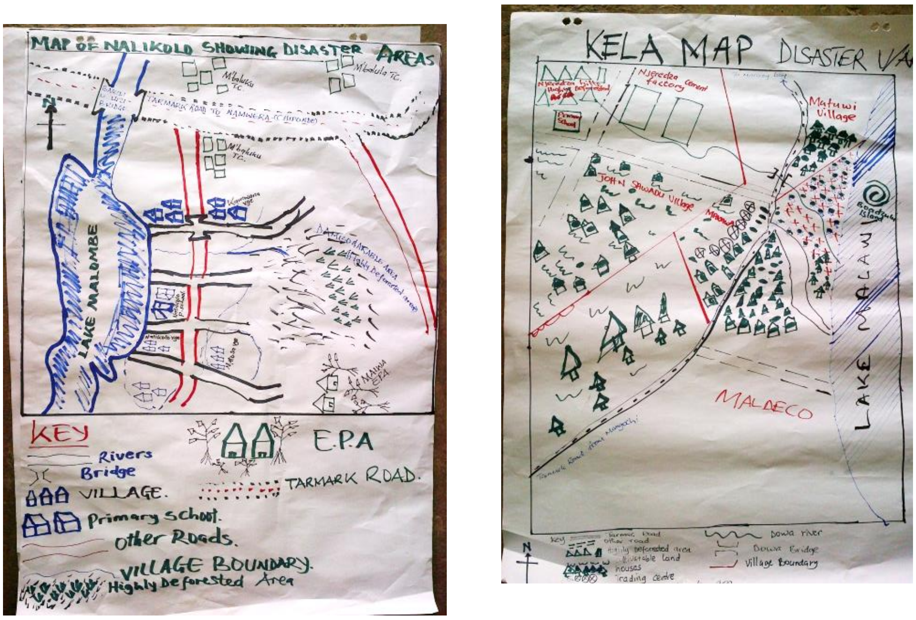


Figure 2.1 Examples of resources maps produced by communities Kela (right) and Nalikolo (left).

3 PVCA Findings

3.1 Analysis of the PVCA Responses

The major climate related hazards in and around the four water bodies were ranked as: floods, prolonged dry spells (or drought) and seasonal strong storms/winds. These are climate related and happen almost every year. All the four selected communities mentioned these climate threats and were able to prioritize by severity (Figure 3.1).

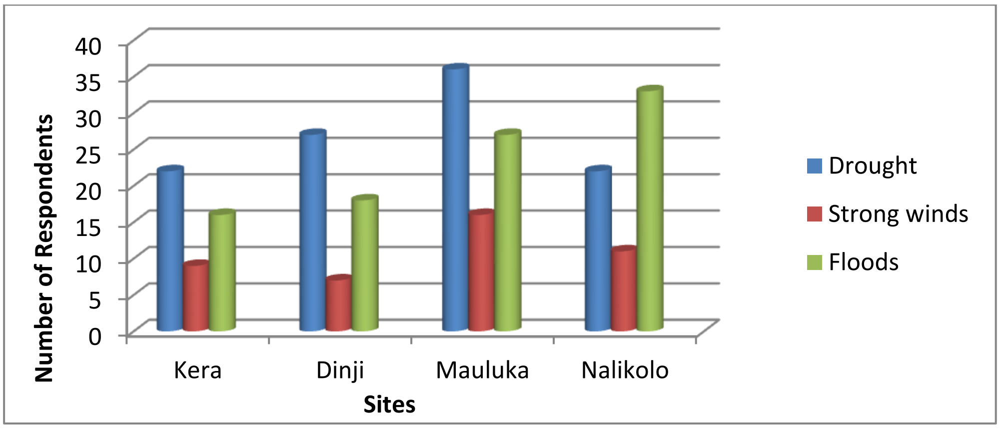
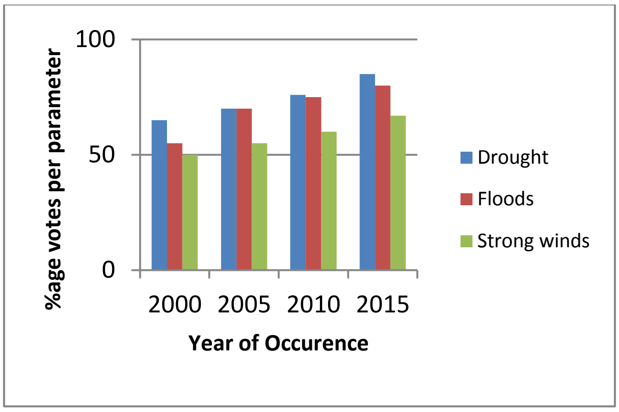


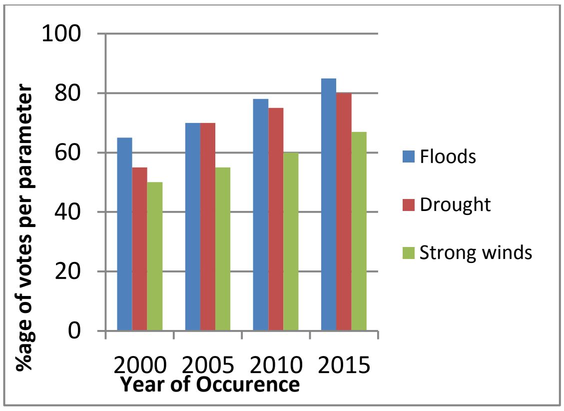
Figure 3.1 Ranking of climate risks by the four communities based on respondent replies

While flood incidents were reported as occurring almost every two years, dry spells occur every three weeks within the rainy season with serious dry spells occurring every 2-3 year intervals. The recent serious dry spells occurred in the 2014-15 season and was preceded by uneven rains in the early part of the 2014-15 growing season (Nov –Dec 2014). This was then followed by destructive rains characterized by heavy down pours for almost a month which brought floods which washed away some crops (rice and maize). This was around January

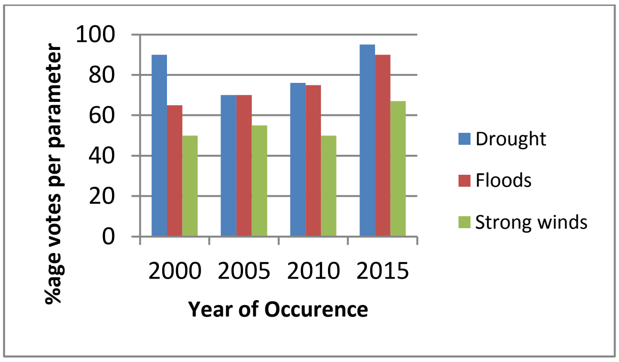
2015, succeeded by a prolonged dry spell which extended through to the end of the season. These occurrences seem to be increasingly occurring over the past 15 years (Figure 3.2).



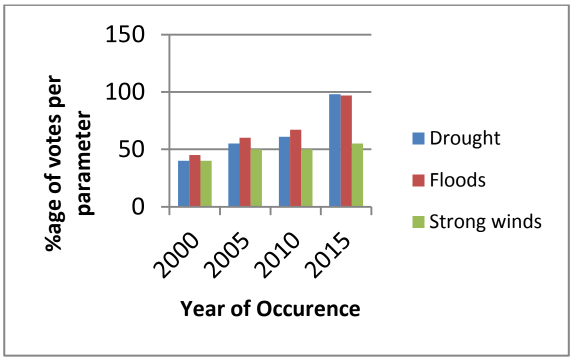
GVH Nalikolo



GVH Dinji



GVH Kela



GVH Mauluka

Figure 3.2 Occurrence of the prioritized climate related risks over the past 15 years

Once they occur, the floods and dry spells have long lasting and serious impacts affecting human, social, physical, economic and environmental aspects of life in the communities. These include displacement of people, loss of lives, crop failures, property loss and other household assets lost like livestock, destruction of road networks and damage to irrigation infrastructures. Floods and dry spells have for the past 10 years been occurring more frequent and simultaneously within a year. However, dry spells have in some years occurred without floods and this has the greatest impact on livelihoods and food security. As a coping strategy, communities around the lakes often look to fishing as an alternative livelihood.

Strong winds were the third major climate risk identified by communities in the four lake areas. In Lake Chiuta for example, storms are highly disruptive as they reduce fishing days and also are a major cause of accidents on the lake, sometimes leading to a loss of lives. In other cases, the strong winds damage houses and other facilities, like roofs of schools and the destruction of farm crops

A matrix of risks, their impacts and vulnerabilities which contributes towards the impacts, is presented in Annex 2.

In all four communities, floods and dry spells are highly unpredictable but reportedly happen between December and February which is the critical period in the farming calendar. Flood occurrence has shown an increasing trend over the past 15 years probably exacerbated by conversion of forests to agriculture land, forest destruction due to charcoal production, firewood collection and fish processing needs. The resultant, lack of tree cover in highly vulnerable steep slopes results in flash floods. Strong winds on the other hand, have been happening at any time of the year especially during the hot months of August to October as well as during the early part of the rainy season.

The destruction of crops from floods and winds (especially rice in Chilwa) further leads to hunger leading to nutrition-related illnesses and mortality in some cases. It also causes, fracturing of families as husbands migrate to towns and Mozambique in search of piecework. Theft and prostitution cases also rise as a way of earning a living in desperate times. Women who are left behind for example, are exposed to transactional "sex for fish trade" with fishermen who usually demand sex in order to sell them their catches (MacPherson et al., 2012). Floods also disrupt education as school blocks either fall or are turned into evacuation centers.

During periods of crop failure in all the four lakes, piecework, fuelwood and charcoal selling are the major means of survival for upland communities. Some community members especially those from Lske Malwi and L. Chilwa, in times of shock, resort to cutting of reeds (ie. phragmites or *Typha) (Cyperus papyrus)* from the lakes and other associated aquatic vegetation (locally known as Milulu) for sale to fish drying racks makers, home building, mat weavers, and as a result destroying or degrading some vital fish breeding habitats.

3.2 Climate Vulnerability Assessment

Looking at the human, social, physical, economic and environmental conditions that have, or would be worsened by, the impacts of the climate related hazards and the risks to livelihoods and food security, it was evident that there are interrelated factors underpinning the critical vulnerability of the communities. The underlying causes of the climate change risks (floods, droughts and destructive winds) in the above matrix identified through discussions were as follows:

a. ***Inadequate early warning* systems** on the impending climate related disaster at community level which would allow them to take mitigation actions. Currently the communities are ill prepared to deal with climate related disasters as they are not able to be informed in time, or not to be informed altogether about weather events that can seriously disrupt their livelihoods. Although the FISH socio-economic baseline study suggests that many people are able to receive weather/climate reports, this study showed that very few are able to access this information at community level. Although in many cases the Meteorology Department produces reports which are aired on the radio, many community members are either not aware of them nor take heed of them. The inadequacy of early warning systems has serious effect on all communities' members, but farmers and fishermen bear the brunt through loss of their farm crops and at times, their lives.

b. ***Limited alternative livelihoods***: The limited availability of other viable alternative and complementary livelihoods for the lakeshore communities pushes the majority of people to fishing as a coping strategy in times of stress and consequently could result in overfishing. During times of heavy storms, fishers have little alternative occupations. Furthermore, while the majority of the lake communities' main livelihoods depend on fishing or fish trade, women mostly do farming activities and therefore are also affected by either drought/dry spell or floods. In addition, in Lake Chilwa, at a time of stress, fishers turn to bird hunting.

c. ***Unsustainable farming practices and limited knowledge of conservation benefits:*** Due to inadequate and unresponsive extension services and high population the resultant pressure for new farmland means that communities in lakeshore rain shadow areas are farming in vulnerable marginal catchments, or opening up new farms in previous forested areas further increasing deforestation, forest degradation and poor agriculture, leading to increased soil erosion and run-off. These actions, in turn lead to frequent flooding occurrences and sedimentation of aquatic environments. The encroachment on forest areas and the associated deforestation and forest degradation is also a consequence of limited knowledge of environmental conservation benefits, or is done out of desperation as there are no alternatives due to competition for land. The resultant susceptibility to flooding increases further downstream of a water course, making the households living in this area more prone, and therefore more vulnerable, to flood impacts as their crops (and homesteads) are washed away and community infrastructure is equally affected. In flat terrain like those of Lake Chiuta and Lake Chilwa floodplains the majority of the communities are affected by the rise in water levels due to these floods, and often, cholera outbreaks are recorded.

d. ***Deforestation:*** Has increased the area of bare land especially in the steep slopes of the Rift Valley (e.g. Perilongwe forest reserve has seen a loss in 80% of forest cover) surrounding the four lakes thereby reducing water retention and soil water infiltration resulting in a higher risk of flash floods.

e. ***Inadequate knowledge*** in agricultural adaptive systems and lack of capacity to adopt new resilient agro-ecosystems to combat climate change impacts e.g. climate smart agriculture (CSA) in drought prone areas.

f. ***Low education and illiteracy:*** From the exercise, it was very evident that literacy levels are very low in the rural society and that this affects communities' capacities to understand issues and leaves them with limited tools and knowledge to employ CCA activities. Baseline socio-economic results conducted by FISH show that the literacy levels in the project area range from 1-17 percent. Efforts to increase the literacy level of such communities can prepare them to access knowledge to combat new and bigger challenges that come along with climate change.

3.3 Climate Adaptation Capacity Analysis

Although the current situation of lack of knowledge in climate proofing is undesirable, existing capacities in CSA in decentralization structures, indigenous knowledge climate oriented systems, and social networks within the communities could be mobilized to enhance resilience and adaptation of these communities affected most by climate change. These structures can be well utilized for climate change information flow and formation of nuclei of community learning in CCA approaches. Additionally, social, NGO and religious groupings that naturally occur in the four communities and different line ministries could support efforts towards auctioning climate change resilience, mitigation and adaptation. For example, other stakeholders, like the ministry of health have, through these structures, been able to disseminate their information and messages.

3.3.1 Institutional Support for CCA

The four communities visited have many community institutions already in place which can assist to enable mobilization of activities in climate change mitigation and adaptation. The VNRMCs, the VCPCs, the FAs, BVCs, VDCs and ADCs are all development oriented institutions and can contribute towards mobilizing communities in CCA activities (Table 3.1.).

Table 3.1 Local institutions that can be mobilized for CCA support

Site	Local Institutions Available
Kela GVH Matuwi	VCPC, ADC, VDC, Village Health Committee, FA, BVC, VNRMCs, School committees, Farmer groups,
Nalikolo	
Dinji (Chiuta)	
Lake Chilwa (Mauluka)	

The challenge to these institutions however is that many of them are inactive and only become active when called to duty by development agents (e.g. NGOs and government), or when there is project funding. Given this pattern of participation, sustainability becomes questionable. This renders them ineffective since they need to be dynamic and continuously functional as community support structures to sustain outcomes of interventions.

In addition, these existing institutions are not properly oriented in CCA and disaster risk reduction issues. For example, the VCPCs in all four sites indicated that they had some sort of limited orientation in issues of CCA and disaster risk reduction and preparedness but had limited tools and knowledge, and therefore do not fully understand their roles and the contribution that they could make. BVC members, for examples, only cited patrolling and confiscation of illegal gears as their sole role. On the other hand, the VNRMC members looked at their role as limited to planting trees and ensuring their protection and had limited CCA capacity and tools and knowledge. They seem to have very limited access to technology of any climate mitigation measures they could support.

Government line ministries' extension services network is still functional to a greater extent in all these areas; these include those from fisheries, forest, agriculture, and department of renewable energy. However, in some cases, the extension officers, for varying reasons live away from their designated catchment and community which deprives the communities of the essential services they are supposed to provide. This is further compounded by challenges of inadequate resources from the central government (e.g. financing) and lack of appropriate applied technological solutions in ready-made extension packages e.g. the BVC Manual is outdated since 2002 and is no longer readily available to all fisheries extension workers to help build BVC capacity. The CSA Manual was only released in 2015, and therefore has not yet been applied universally in the project area.

3.3.2 Natural & Social Capital

Communities in all the sampled areas noted that they have natural capital in the form of their land, lakes, the remaining patches of forests, living organisms including fish and all formations of the biosphere which provide them with ecosystem goods and services for their survival and well-being. They acknowledged that harvesting these form the basis of their livelihood activities. Sustainable management of these resources however need appropriate skills, some level of knowledge and science, and necessary attitudes and governance ability to exploit them sustainably, as well as tools for enhanced CCA, resilience and mitigation. Without enforcement of sustainable management practices these resources will dwindle and become exploited to the point they become sources of conflicts between multiple users.

The rivers which were dry at the time of the study, reportedly, in the past 10 years, used to run throughout the year (but currently only run from the onset of rains in December through to the beginning of May every year). These rivers—including the Dowa, Katondo (currently filled), Katekwere, Chikwizimbi, Dulanyenje, Lingala and Nakhombe —used to serve as sources of water for irrigation for winter cropping (e.g. rice). Interventions to prevent drying of the remaining rivers and maintaining perennial water in streams and wetlands would assist to increase their cropping times in winter thereby increasing their resilience. There is a need to establish river line buffer zones to avoid soil and bank erosion a result of bank vegetation clearing for cropping, or during deforestation.

Government resettlement schemes also have had some negative effects on Kela (Matuwi area) community. The newly resettled community upstream of the Dowa River has adopted charcoal production for sale as their core and sole source of livelihood. Although deforestation happens well out of the catchment area in Njereza, it has a very negative effect on areas around Kela as the severity of flash floods has been exacerbated by the denuded landscape and surface flow plowing through their neighborhoods almost yearly, with the worst being during the 2015 rainy season. There is therefore a need for a catchment-wide conservation approach to include Njereza communities. At district level, authorities can intervene through the VDCs as well as ADCs to try to empower the Njereza communities to employ alternative livelihoods other than their reliance on fuelwood selling and charcoal production.

All the four communities (areas) have notably well-organized social structures with long standing trust and sustained confidence which could form the nucleus of understanding and effort mobilization. It was noted that the four communities have come together under several other local projects in their respective localities without any external interventions. These communities for example, have been involved in many public works programs including construction of small bridges and maintenance of roads within their areas. They have also together been involved in other activities such as tree nursery management. External efforts can therefore be based on these local initiatives, appeal to leadership relationships and social capital to build on skills and knowledge development for climate change resilience and mitigation efforts.

3.3.3 Climate Change Adaptation Livelihoods

The study established that in the four GVH communities, although fishing predominates (67-86 percent), most have a number of other livelihoods that supplement and/or complement fishing (Table 3.2). While some community members assist in the fishing operations, they are also involved in farming (45-94 percent), own small businesses or are engaged in fish trading at the beach (63-79 percent). Some of these community members live far away from the beaches, but nevertheless still have effective connections to beach activities and the fishery. Consequently, they are also affected by what happens to the fishery as money circulation and economic activities within their communities depends on fish catches and trade.

Table 3.2 Livelihood Activities in the Four Lake Communities (multiple responses) (%)

Livelihood Activity	L. Chilwa	L. Chiuta	L. Malawi	L. Malombe
Farming	94	67	45	78
Farm produce trading	35	30	36	66
Ganyu/piecework (all types)	56	65	72	70
Fish trading	63	70	78	79
Firewood & charcoal trading	37	37	46	37
Small businesses (groceries)	52	68	72	67
Fishing	67	78	86	73

(Source: FISH Socio-economic baseline survey)

4 Analysis of Dynamic Climate-Related Pressures and Underlying Causes

4.1 Understanding the Causes of Vulnerability

Natural resources like rivers and fertile soils are at risk of climate and human induced degradation and therefore need protection. Although the communities benefit from dimba farming in wetlands along floodplains that have retained residual moisture e.g. Chikwizimbi and Chitekwe rivers for winter cropping (maize, beans and sweet potatoes), they lack the technical tools and capacities to protect these wetland resources from encroachment and degradation.

The survey showed that there is inadequate community material support, knowledge and skills in managing and utilizing climate-smart tools and a poor understanding of how a lack of adoption of CCA techniques puts them at increasing risks to the growing effects of climate change. Skills and capacities in sustainable water efficient irrigation, conservation agriculture, climate-smart agriculture and soil and water conservation were mentioned in all the communities as critical to engender sustainable use of natural resources (Table 4.1) yet communities had limited capacities, technology, tools and skills to do this. They were in need of support with best practices options to combat the risks their livelihoods faced.

In addition to the above, expertise in off-farm activities like Village Savings and Loans Associations (VSLA) were also suggested to provide an alternative source of income in times of crop failure or as a source of funds to invest in drought resistant practices like conservation agriculture, CSA, etc. The need to have trained facilitators, technology packages and skills for these approaches was also registered by all groups interviewed.

Table 4.1 Required skills, facilities and programs for climate change adaptation

Water body	Community suggested required skills facilities, and programs
Chilwa (Mauluka)	a. NRBEs best practices b. Early maturing varieties and drought tolerant crops c. Expansion of large scale irrigation (canal) d. Establishment of well-trained civil protection committees (CPCs) e. Village banks or VSLA scheme f. Entrepreneurship skills g. Agriculture value chain development h. Alternative livelihoods that may provide less reliance on farming i. Climate smart agriculture
Chiuta (Dinji)	a. NRBEs best practices, b. VSLA scheme, c. Afforestation, to provide buffer from strong winds against their houses, d. Income generating activities to diversify their livelihoods e. Conservation agriculture skills f. Water harvesting technology.
L. Malawi	a. Afforestation (trees), to provide buffer from strong winds against their houses, b. Income generating activities to diversify their livelihoods, c. Conservation agriculture skills d. Water harvesting technology e. Building of a strong and raised bridge over the tarmac road f. Engaging the Njereza community to reduce deforestation
L. Malombe	a. Afforestation, community banking (VSLA) b. Land resource management skills, c. Business skills, d. Alternative sources of income that are resilient to flooding e. Agriculture value chains f. Entrepreneurship skills g. Village banks or VSLA

4.2 Early Warning Systems

The International Strategy for Disaster Reduction (ISDR) proposes ways and measures to reduce the impact of disasters and further encourages the development of appropriate early warning systems. Early warning systems are described as a set of capacities needed to generate and disseminate timely and meaningful warning information to enable communities threatened by a hazard to prepare and to act appropriately in sufficient time to reduce the possibility of harm or loss (ISDR, 2009, in USAID 2009).

In the discussions with all the sampled communities it was also noted that inadequate and inappropriate dissemination methods of early warning systems (warnings about floods, dry spells and strong winds) increase the impacts of these events as people are caught unawares when these will occur. In all the visited communities, traditional early warning signals to rains and floods gained over the generations, are available to predict heavy rains or dry spells. This also includes the direction and/or onset of the first rains. For example, very hot temperatures around October are a sign of good rains. These are not documented but have been passed down through generations and have not been modified despite observed variations due to climate change impacts. Communities, therefore have not adapted to climate change and have no inbuilt means to gauge how to use traditional knowledge to predict climate variability brought about by global warming.

Early warning signals for heavy storms were not well articulated in traditional knowledge, perhaps a sign of their nonexistence or low occurrence in history which puts the fishers at high risk of storms while out fishing, and a risk of drowning. Communities in the four sites recall six occasions in the past five years where storms have resulted in the loss of life. It was however agreed that traditional early warning signals are not deterministic and are increasingly losing accuracy; hence the need for more scientific based weather information, early warning tools and more sophisticated equipment and methods for weather forecasting.

The UN/ISDR Platform for the Promotion of Early Warning (2006) advocates the following four elements for people-centred early warning systems to be effective:

1. Systematic collection of data;
2. Determination and communication;
3. Monitoring and warning services; and
4. Enhancing response capabilities.

The SADC Climate Services Centre, for example, provides such a system which could possibly be effective in providing much needed information to communities and other weather information users;

5 Early Warning Forecasting

5.1 SADC National Forecasts

SADC provides annual regional and national weather forecasts to countries within the region to help guide countries in their national weather forecasting and also planning for disasters. For example, the SADC forecast model predicts that there is a high probability (over 90 percent) that a strong El Niño will develop in the 2015/16 season and persist throughout the Southern Hemisphere summer of 2015-16. These reports when used together with local weather forecasts by the Meteorological Department, that were readily accessible, and this information, could help guide FISH communities' in their CCA decisions.

Consistent (yearly) provision of the above information for example, would inform the communities' of the likelihoods of exposure to potential floods and dry spells. This would in turn inform their choices in crops they can grow and best land use practices within a particular year, time of planting, need to use drought resistant seed, etc.

There are other opportunities for the FISH project to leverage around early warning systems, beyond the SADC Climate Services Centre. For example, a recently approved project supported by the UNDP and funded through the Green Climate Fund (UNDP, 2015) will provide new opportunities to scale up the use of climate information and early warnings in Malawi. The project focuses on building weather and climate-related services for use by farmers, fishers and communities in general impacted by climate change to plan their on-farm activities and be forewarned of severe weather that could cause flooding or dangerous fishing conditions. Implemented by the DoDMA with support from the Department of Climate Change Meteorological Services, Department of Water Resources, agricultural extension services, fisheries and farmer agencies, the project will use ICT/mobile, print and radio channels to disseminate its weather- and climate-based advisories. FIDH should link its mobile communication network of FISH Technicians with this system so as to better inform its communities.

5.2 Poverty, Population and Climate

Communities explained that poverty as a driver necessitated the need to survive from nature and the increased population growth further fuel pressures on natural resources resulting in the conversion of pristine forest areas and marginal land into deforested areas for fuelwood and charcoal, agriculture and human settlements. As the population continues to surge and people have limited livelihood options more people revert to livelihoods that depend on open access to nature; i.e. timber and non-timber forest products (e.g. wildlife) and fisheries, and other common goods. In the face of almost unregulated resource exploitation, this situation exerts pressure on natural resources leading to their unsustainable utilization and subsequent degradation. This degradation—especially of catchments—renders them less resilient to the impacts of climate change and places local lives and downstream activities at risk.

Generally, it was noted that natural resources were viewed by community members to belong to the government and therefore are the states responsibility to manage, absolving the community of responsibility for the damage they do. In practice however, government does not have adequate financial and human capacity to manage natural resources and consequently, natural resources have ended up being common pool resources. This lack of ownership of natural resources has led to overexploitation and degradation of forests, rivers, land, soils and fisheries which, coupled with climate impacts, makes for even greater vulnerability. However, for the past 2 decades, the state aided by donors has tried to promote community based natural resource management in fisheries and forestry, with little success.

The failure of the remaining arable land to support the growing communities' livelihoods and food security needs was mentioned as a major cause of overfishing since more community members—who in the past were not engaged in fishing—are now entering the fisheries sector. This unrestricted entrants is contributing to further overexploitation and illegal use of the fish resources. Communities perceive that if rains were normal and reliable enough, pressure and reliance on the fishery would not have been as heavy as it is now. Furthermore, communities, however, acknowledged that because of the small catches that are realized nowadays most of them are involved in both fishing as well as farming. This means that when there are poor rains in a year they become victims on both fronts. However, this is a little confusing in that in Lake Malawi, fish production has increased 10 fold in the last decade due to Usipa production, now topping 100,000 tons/year.

6 Conclusions and Recommendations

6.1 Summary of Vulnerability Findings

The following Table 6.1 summarizes climate change risks and recommends an action plan specific to the measures FISH should employ to instill CCA knowledge, tools and skills in the target areas looking at fisheries and related agriculture:

Table 6.1 Summary Action Plan and Measures to Instill CCA

Climate Change Risk	Impacts	Stakeholders Affected	CCA Measures	Benefit
Increased frequency and severity of storms (mwera winds)	**Increased post-harvest losses** resulting from stranded fishers without ice staying longer on distant beaches and **low catches** due to reduced fishing days Increased accidents at sea due to storms.	Fishers	**Improved weather forecasting and accessibility of weather information through** mobile technology, provision of up to date information on winds (speed). This can prevent fishers from getting back to home, leading to stranding on the lake by going to safe harbours during storms, and loss in catches going bad.	**Reduction in accidents** (capsizing of boats due to heavy storms); **reduced post-harvest losses** as cases of fishermen staying longer in remote shores due to bad weather will be reduced
Increased precipitation amount and frequency of rainy days	Poor quality of processed fish, especially sun dried, necessitating cooking (i.e. frying or parboiling), leading to increased firewood use and forest degradation. Intense rainy days leads to floods result in high run-off, catchment erosion and flooded crops, loss in crop yields.	Fish Processors Shoreline farming communities	**Improved weather forecasting and accessibility through mobile phones and radio –** This will **a**ssist in decision making on whether to purchase fish for processing or not and which processing method to use in order to reduce post-harvest losses. Provision of improved sun dryer technology to dry fish in cloudy and wet weather. Improved CSA technology provided to shoreline communities.	**Reduced post-harvest losses** and hence increased incomes from fish Reduced crop losses.
Increased precipitation resulting in high nutrient loads and high lake levels	**Increased fish production** due to high recruitment and survival of juveniles resulting from high nutrients; and increased access of fish breeders to breeding and nursery grounds. This has potential to increase yields greater than fish processing capacity, leading to post-harvest losses.	Fishers. Processors, Traders, Consumers	**Improved processing technologies** will ensure that processors have capacity to handle increased catches without increasing post-harvest losses. Educate fishers on risks of overfishing of juvenile fish. Explore export markets that can absorb fish during the season of plenty.	**Increased fish supply and stabilized prices**
Increased precipitation resulting in flooding, increased soil erosion and siltation of rivers and lakes, destroying crops.	**Reduced market access** due to road damage.	Fishers, processors, traders, consumers and farmers	**Improved catchment management** (within 10km zone) to reduce erosion and flood damage of roads and agricultural land.	**Increased access to markets** during rainy season, **stabilized fish supply** in rain season. Improved crop yields and resilience due to CSA technology.

	Reduced breeding due to siltation of riverine breeding areas	Fishers	Improved catchment management (within 10km zone) to reduce erosion and flood damage of roads	**Increased fish production** due to undisturbed recruitment
	Increased fish production especially of small species such as Usipa due to nutrient enrichment of lake from soil erosion and silt loads	Fishers; processors; traders and consumers	**Reduce postharvest** losses and increased value addition to get more value from small low value species	**Increased fish supply and incomes to fishers, processors and traders**
High temperatures, low precipitation resulting in low lake levels	**Reduced catches** due to low recruitment as emerged vegetation is exposed and no longer provide sanctuary Destruction of EAV (e.g. Reeds harvested for building racks, weaving, or as traps, etc).	Fishers, traders and consumers	**Improved culture based technology**, placement of brush parks to become artificial refugia in shallows and deep pools (in Lake Chilwa)	Protecting recruitment stock will allow quick recovery and fishery restoration.
	Increased catches (in Lake Chilwa) due to low levels causing increased fish catchability	Fishers	Develop BVCs as governance body to regulate fishing during low water levels	Quicker recovery of stocks
Drought affecting land based food crops and livelihoods	**Increased fishing effort-** Famine will increase pressure on fishery as fishers increase effort to compensate low maize yields; new entrants (fishers and traders) and migrants increase fishing effort and demand for fish as they diversify livelihoods to fishing	Farmers, fishing communities	**Improved governance and enforcement** to ensure that effort matches fish resources (fisheries management plan); Practicing of CSA for adaptation and mitigation.	Reduced fishing effort and illegal fishing. Increased food security.
	Failed crop farmers turn to fishing as a coping strategy	Farmers and fishers	**Increase adaptive capacity of fishers and fishing communities by diversifying livelihood options** and increasing adoption of drought resistant agriculture technologies that increase resilience of agricultural ecosystems and farmers to climate change impacts	**Reduced fishing effort and illegal fishing** by farmers whose crops would have failed

6.2 Comprehensive Adaptation Options

The IPCC defines adaptation as the adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects which moderate, harm or exploit beneficial opportunities. Mitchell and Tanner (2006) defines adaptation as an understanding of how individuals groups or natural systems can prepare for and respond to changes in climate or their environment. The following therefore would be the key attributes to bring about such a change:

a. Increased science based knowledge and awareness across the communities on the meaning and impacts of changing climate and how their actions can exacerbate the situation (e.g. deforestation = floods).
b. Skills and knowledge in disaster risk reduction actions by communities, coupled with early warning systems and emergency plans;
c. Strengthening the district and community institutions through capacity building in CCA tools and techniques, climate proofing livelihoods to foster community resilience to climate change.
d. Adoption of climate adaptation tools and promotion of adaptive Climate Smart Agriculture (CSA) technologies e.g. through drought tolerant crops, conservation agriculture, agroforestry and vegetative propagation interventions to re-forest degraded catchments.

In view of the analysis of the four communities' capacities, and underlying causes of climate change effects on their livelihoods, a comprehensive approach to promote CCA is highly recommended to counter the growing effect of the creeping changes climate vagrancies will bring. The following activities have been recommended by this PVCA:

a. Strengthening of District and Community structures to enable them to plan and implement risk reduction interventions through the inclusion of recommended best practices into the District Development Plans (DDPs). This could be achieved by embarking on capacity development of the community structures like VNRMCs, BVCs, FAs, farmers clubs, including the VDCs through provision of technical, as well as, disaster management trainings and emergency plans.
b. Facilitating the localizing of some community based early warning systems that use scientific and traditional information to enhance the interface between the climate service providers and communities/users so as to enhance the adoption rates.
c. Supporting appropriate communication methods (e.g. mobile/SMS technology) to distribute weather information widely and timely to assist the rural communities, especially issuance of storm warnings for fishers.
d. Promotion of CSA and integrated natural resources management skills like integrated agriculture (e.g. crop/livestock/aquaculture) including encouraging regeneration of degraded land e.g. all year round tree vegetative planting through use of truncheons, and introducing more drought tolerant crop diversification as a buffer against crop failure.
e. Enhancing the local knowledge in science of NRM and in governance for co-management of natural resources like water, fish, wildlife, vegetation and forested areas to instill ownership and embrace sustainable use patterns.

f. Supporting government approach in climate-smart adaptive agricultural technologies including irrigation and CSA through technical trainings of extension agents (i.e. FISH technician and counterparts) and using demonstrations of climate proofing and lead persons as model farmers to spread the knowledge.
g. Supporting agricultural produce/crop/livestock diversification that both matches local climatic conditions and that spreads the risk of failure.
h. Promotion and supporting of off-farm livelihood activities like VSLAs and other non-timber forest products that sustainably utilize natural resources e.g. bee keeping but that also buffer against crop failure and provide alternative income streams.
i. Enhancing the knowledge and benefits of fisheries ownership and resource management through FA/BVC, and introduce climate smart best practices.
j. Enhancing the knowledge and benefits of natural resource ownership and management through VNRMCs, and introduce climate smart best practices.
k. Focus inputs around the vulnerable areas in the rain shadow, with notable hot spots along the shores of Lake Malawi and Lake Malombe.

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Annex 1: PVCA Data Collection Questionnaire

A. Hazard Analysis **B. Site**

Attendance:			
Question	**Hazard 1**	**Hazard 2**	**Hazard 3**
1 **TYPE:** What hazards/disasters commonly affect your community?			
2 **SIGNIFICANCE:** Which would you consider to be the most serious hazard, in terms of impact upon the community? (Do a ranking exercise.)	1.	2.	
3 **HISTORY** What was the last significant disaster event to affect this community, and when was it?			
4 **FREQUENCY** How often does this hazard occur (eg every year, one year in three etc)?			
5 **SEVERITY** How do you measure the severity of the hazard (eg depth of water, wind speed, lack of rain, damage)? What would you observe in a good year and a bad year?		-	
6 **DURATION** How long does the hazard persist (hours, days, weeks, months, years)?			
7 **LOCATION / AREA** Which parts of the community are worst affected? (Could show on map.)			

8 **SIGNS** Any early warnings, traditional or from government? How quickly (or slowly) does the hazard appear?	-	-	
9 **TRENDS** What changes are happening to the frequency, duration or severity of the hazard? Any new hazards?			

<u>TASKS:</u>

1. Through PRA tools (e.g FGD, community mapping, etc) identify 3 major hazards affecting the community
2. Describe the hazards according to leading questions 3-9

<u>NB:</u>

A. This is section is done for each Hazard

B. Elements At Risk (EAR):

B. Impact & Vulnerability Analysis -

Hazard Type:			
ASPECTS OF LIFE	**ELEMENT AT RISK**	**IMPACT ON ELEMENT AT RISK**	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**
Human		-	-
Physical			

Social	-	-	
Economic			
Environmental	-	-	-

TASKS:

1. From the community map, identify elements at risk according in line with the aspects of life
2. In bullet form, define how each element is impacted by the hazards
3. Discuss why the elements are affected in that way **(vulnerability**)

NB:

C. This is section is done for each Hazard

D. Elements At Risk (EAR):

B. Impact & Vulnerability Analysis -

Hazard Type:			
ASPECTS OF LIFE	**ELEMENT AT RISK**	**IMPACT ON ELEMENT AT RISK**	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**

Human			
Physical		-	-
Social	-		
Economic	-		
Environmental	-		-

TASKS:

4. From the community map, identify elements at risk according in line with the aspects of life
5. In bullet form, define how each element is impacted by the hazards
6. Discuss why the elements are affected in that way **(vulnerability**)

NB:

- **E. This is section is done for each Hazard**
- F. **Elements At Risk (EAR):**

B. Impact & Vulnerability Analysis -

Hazard Type:			
ASPECTS OF LIFE	**ELEMENT AT RISK**	**IMPACT ON ELEMENT AT RISK**	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**
Human		-	-
Physical		-	-
Social	-	-	-
Economic		-	-
Environmental	-		-

TASKS:

7. From the community map, identify elements at risk according in line with the aspects of life
8. In bullet form, define how each element is impacted by the hazards
9. Discuss why the elements are affected in that way **(vulnerability**)

C. Capacity

Hazard:

Hazard: Drought			
ASPECTS OF LIFE	**IMPACTS ON ELEMENT AT RISK**	**Available CAPACITIES**	**Required CAPACITIES**
Human	-		-
Physical			
Social	-		
Economic	-	-	
Environmental	-	-	-

TASKS:

1. From the hazard assessment, copy down impacts of the hazard under discussion
2. Identify human, physical, social, economic and environmental assets the community has that can be used to lessen the identified impacts

C. Capacity

Hazard: Floods			
ASPECTS OF LIFE	**IMPACTS ON ELEMENT AT RISK**	**Available CAPACITIES**	**Required CAPACITIES**
Human		-	-
Physical	-	-	-
Social	-	-	-
Economic		-	-
Environmental		-	-

TASKS:

3. From the hazard assessment, copy down impacts of the hazard under discussion
4. Identify human, physical, social, economic and environmental assets the community has that can be used to lessen the identified impacts

C.	**Capacity**

Hazard:			
ASPECTS OF LIFE	**IMPACTS ON ELEMENT AT RISK**	**Available CAPACITIES**	**Required CAPACITIES**
Human	-		-
Physical	-		
Social	-		
Economic	-	-	-
Environmental		-	-

TASKS:

5. From the hazard assessment, copy down impacts of the hazard under discussion
6. Identify human, physical, social, economic and environmental assets the community has that can be used to lessen the identified impacts

D. Assessment of Dynamic Pressures and the Underlying

Hazard: Drought			
IMPACT ON ELEMENT AT RISK	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**	**DYNAMIC PRESSURES**	**UNDERLYING CAUSES**
-	-		
	-	-	-
	-	-	-
-		-	-

D. Assessment of Dynamic Pressures and the Underlying Causes

Hazard:			
IMPACT ON ELEMENT AT RISK	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**	**DYNAMIC PRESSURES**	**UNDERLYING CAUSES**
- Eg Loss of life -	-		-

	-		-
	-	-	
-	-		

D. Assessment of Dynamic Pressures and the Underlying Causes

Hazard: Heavy Storms			
IMPACT ON ELEMENT AT RISK	**POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT**	**DYNAMIC PRESSURES**	**UNDERLYING CAUSES**
-	-		
-	-		-
-	-	-	-

-	-	-	-
	-	-	-

TASKS:

1. From the impact and vulnerability assessment, copy down impacts of the hazard and the existing vulnerabilities
2. Identify key relevant and reliable informants that can talk more about the hazard
3. Ask the informants about the existing **structures** and **processes** that worsen or lessen the hazard impacts. Record responses in column 3 against each impact
4. Find out from the informants or other sources why such structures are in existence and/or why such processes are followed. Record responses in column 4 against each impact
5. Optionally, ask what the informants think would be the right structures and/or processes

E. Analysis and Reporting	
HAZARD ANALYSIS	
i. What are the major hazards as identified through communities' participation ii. What is the severity of each hazard iii. What is the trend of each hazard iv. What are the impacts of each hazard on human, social, physical, economic and environmental aspects of life (elements at risk)	
VULNERABILITY ANALYSIS	
i. What are the human, social, physical, economic and environmental conditions that or would worsen the impacts of the hazards on the elements at risk	
CAPACITY ANALYSIS	

i. What capacities are available at district level that could be used to address the identified vulnerabilities as a way of addressing the impacts of the hazards? (This could include relevant current district interventions, plans, NGOs and projects, skills etc.) ii. What capacities are required at district and community levels that could be used to address the identified vulnerabilities as a way of addressing the impacts of the hazards	
ANALYSIS OF DYNAMIC PRESSURES AND UNDERLYING CUASES	
i. What other institutional- cultural and political- **structures** that play a role in worsening the impacts of the hazards on the elements at risk ii. What other institutional- cultural (e.g gender), political- **process** that play a role in worsening the impacts of the hazards on the elements at risk	
SUGGESTED PROJECT ACTIVITIES	
i. What change would you like to see against the identified vulnerabilities ii. What activities would be appropriate to attain the change iii. What change would you like to see against the identified dynamic pressures (structures) and the underlying causes (process) iv. What activities would be appropriate to attain the change	

Some PRA tools that would be used in PVCA Process		
TOOL	**WHICH PVCA STEPS?**	**PURPOSE**
Community mapping	Step 2: Hazard assessment Step 3: Vulnerability and capacity assessment Step 5: Risk management plans	To show buildings, structures and natural resources To show areas and resources affected by the hazard To show the capacities – things which are unaffected by the hazard To identify safe areas and define safe evacuation routes for contingency plans

Ranking	Step 2: Hazard assessment Step 3: Vulnerability and capacity assessment Step 5: Risk management plans	To determine which hazard or which impact of the hazard is of most significance to community To show which natural resources are most important To help people agree on which vulnerability is a priority and should be addressed first in planning
Timeline	Step 2: Hazard assessment	To show the history of local disaster events To identify any changes or trends in hazard type, frequency or intensity, giving clues for the future
Seasonal Calendar	Step 2: Hazard assessment Step 3: Vulnerability and capacity assessment Step 5: Risk management plans	To show the specific times of year when hazards and livelihood activities occur, and which activities are most at risk To show the safer seasons of the year, which should be used to the full for agriculture and other livelihoods99
Venn Diagram	Step 3: Vulnerability and capacity assessment Step 5: Risk management plans	To give a visual representation of the various social groups, demonstrating their relative importance and relationships between them To identify under-used groups which have capacities To identify groups which may need to be influenced to bring about change to a structure or a process affecting the community (a dynamic pressure)
Transect Walk	Step 3: Vulnerability and capacity assessment	To gather additional information about the capacities and vulnerabilities in the community

Annex 2

Results matrix of risks, their impacts and vulnerabilities which contributes towards the climate change impacts

A. Hazard Type: Dry Spells

ASPECTS OF LIFE	ELEMENT AT RISK	IMPACT ON ELEMENT AT RISK	POSSIBLE VULNERABILITIES WHICH ALLOW THIS IMPACT
Human	All age groups and sex	- Shortage of food - Prostitution - Leads to promiscuity in search for livelihood which increases HIV & AIDS cases. (Increase in number of orphans - Unstable marriages - Increase in School dropout rate	- Deforestation for firewood selling at the lake, which is used for fry fish and the women get some cash from the sales - Poor farming practices which promotes running water and thereby allowing land to dry in the shortest possible time even though there have been a heavy down pour in the recent days
Physical	Crops	- Wilting crops and low to no production	- Our farming depends on rainfall therefore if the spells continue then we expect crop failure. - Those who adopted practice CA through the ministry of agriculture do better because regardless of the crop wilting their crops do not reach a permanent wilting point
Social	Loss of social cohesion	- Stealing of property - Families become stingy with their food, no sharing of food every family for themselves	- Lack of alternative livelihoods to resort to complement the farming as source of income and food
Economic	- Livestock - Household income - Household productive assets	- Lost labour to piece work instead own farm - Loss of income - Income being diverted to purchase of food neglecting other needs such as school expenses - Loss of organized near livestock drinking points which leads to low productivity in livestock	- Unavailability l livestock drinking points - Low yields affecting agribusiness - Lack of household income - Loss of labour - Lack of entrepreneurship skills - Lack of variable agricultural value chains

Environmental	- Trees - Grazing land - Farming land - Lakes - Water levels	- There is deforestation for selling of firewood at L. Chilwa for drying of FISH - Deforestation due to charcoal burning - Drying of grazing land - Water scarcity - Overfishing - Low water levels in the lake - People priorities other need other than NRM activities	- Lack of skills and knowledge in natural resource management - Lack of alternative IGA - Land under poor agricultural practices that exposes top soil to erosion - In some cases overfishing is done because of lack of enforced regulation Low levels are also promoted because of lack of perennial rivers that could be supplying more water to the lake. In some cases the rivers which used to run throughout the year are drying therefore there is less water in the lake

B. Hazard Type: Floods

ASPECTS OF LIFE	ELEMENT AT RISK	IMPACT ON ELEMENT AT RISK	POSSIBLE VULNERABILITIES THAT ALLOW THIS IMPACT
Human	All age groups and sex	- Loss of life, property - Loss of labour - Children can't go to school - Poor nutrition because depend on food aid - Leading to physical disabilities	- Deforestation - Increase in human population which leads people to cultivate along river banks due to land scarcity - Nutrition related deaths - Diseases
Physical	- Buildings, houses, shops - Bridges	- Infrastructure destruction such as bridges, houses, granaries & other buildings - Road communication breakdown	- Substandard buildings due to high cost of building materials - Lack of skills in building construction

Social	- Social cohesion - Marital relationship	- Separation of families/couples leading no sex in couple leading to promiscuity (contracting STD, HIV &AIDS) - Loss of human dignity due to people of different sex sleeping together - Displacement of people due to River e.g. Duwa flooding.	- Low incomes - Lack of diverse livelihoods - Encroachment of river banks
Economic	- Labour - Household assets - Livestock - Crops	- Loss of HHs productive assets - Crop destruction - Loss of livestock	- Lack of skills to cope with stress - Lack of job opportunities - Lack of skills in entrepreneurship - Shortage of irrigable land
Environmental	- Water - Nature vegetation - Soil - Crops - River siltation	- Soil erosion - Water pollution (water borne diseases)	- Deforestation - Cultivating along river banks - Poor natural resource management at the catchment of the Rivers

C. Hazard Type: Storms

ASPECTS OF LIFE	ELEMENT AT RISK	IMPACT ON ELEMENT AT RISK	POSSIBLE VULNERABILITIES THAT ALLOW THIS IMPACT
Human	All age groups	- Shortage of food - Prostitution - Leads to promiscuity in search for livelihood which increases HIV & AIDS cases. (Increase in number of orphans - Erodes and degrades the upland agricultural land - increase in School dropout rate	- Deforestation for firewood selling at the lake, which is used for fry fish and the women get some cash from the sales - Poor farming practices which promotes running water and thereby allowing land to dry in the shortest possible time even though there have been a heavy down pour in the recent days
Physical	Households & infrastructure	- Loss of infrastructures including schools and roads which complicates the situation even more. - Limited communications - Loss of crops	- Substandard constructed infrastructure e.g. roads and buildings - Poor positioning of infrastructures - Poor drainage systems - Poor farming practices and lack of diversification
Social	Loss of social cohesion	- Stealing of property which destroys the social fabric of the communities and leads to loss of social capital and trust - Families become stingy with their food, no sharing of food every family for themselves - Promiscuity - Overfishing	- Vulnerable families rely on women who have to sell small merchandise and in the process exposing themselves to fishermen who mostly have some monies therefore exposing families to HIV/Aids - Families who have had their crops washed away resort to providing labor to fishers and thereby increasing the frequency of fishing times by a single gear owner
Economic	- Livestock - Household income - Household productive assets	- Lost labour to piece work instead own farm - Loss of income - Income being diverted to purchase of food neglecting other needs such as school expenses - Loss of livestock - Loss of productive assets	- Low yields affecting agribusiness - Lack of household income - Loss of labor - Lack of entrepreneurship skills - Lack of variable agricultural value chains - Lack of alternative livelihoods

Environmental	- Forests and some aquatic vegetation - Grazing land - Farming land - Lakes - Overfishing	- Selling of firewood - Deforestation due to charcoal burning - Drying of grazing land - Water scarcity - Overfishing - Disturbances of FISH breeding sites	- Lack of skills and knowledge in natural resource management - Lack of alternative IGA - In absence of other livelihoods some population cut some aquatic vegetation e.g. leads for mat making for sale